FOOD ADULTERATION IN ITS RELATIONS TO THE PUBLIC HEALTH.

H. W. WILEY, M. D., PH. D., WASHINGTON, D. C.

MR. PRESIDENT, LADIES AND GENTLEMEN—The conservation of the public health is a duty which is not peculiar alone to the medical profession. While the world looks to those of us, who have received medical training and have taken medical degrees, for instruction in hygiene and the rules which should regulate life, the popular idea of the physician is rather one to whom appeal is made when the health is broken and disease has seized upon the vital organs. Nevertheless, in spite of this popular impression of the functions of a physician, the world is turning more and more to the physician for information on all subjects which pertain to health and longevity.

The desire to live to "a green old age" should also be accompanied by the effort to make this life as free from disease and suffering as possible. A prolongation of life which means simply the prolongation of an invalid's life is not one to be greatly desired. The economics of valetudinarianism are matters of some moment because the invalid is a burden, either to himself, to his friends or to society at large. The ideal of life, the one which results in work accomplished and in progress achieved, is, other things being equal, a healthy life. I make this statement with a full knowledge that many great works have been accomplished by invalids. Sometimes it may even be said that sickness is the prime cause of great achievements, since it isolates the invalid from contact with the world, and enables him to concentrate his powers upon a single object. But sickness is not necessary to secure concentration of thought and purpose, these can be far better accomplished by the forces of will and the law of habit.

The physician need not be deterred from teaching the laws of health because he fears that he may diminish his professional activity. It requires a certain amount of sickness to kill an invalid and if this be extended over a period of eighty years the physician will make as much out of it as he could have accomplished in forty, so that from a mere business point of view there is no reason why the physician should not be the teacher of hygiene.

Among the many factors which have a great influence upon the health of the individual there is none more potent than food. Eating is the chief industry of the human race. In this country there are about thirty million wage earners, drawing about twenty-five million dollars a day. Of this vast sum fully three-fourths are applied to the

purchase of food and its preparation. It seems to me therefore that a subject which monopolizes three-fourths of the energies of the human race is one which is well worthy of discussion, and especially among a body of physicians, who have banded themselves together not particularly for the curing of disease, but for the more beneficent purpose of conserving the public health.

Often even wholesome foods may be administered in such a way or in such excessive quantities as to injure the health of the consumer. If this be true, how much greater must the danger be if the food offered for consumption be changed in its nature, so as to become a positive poison, by the addition of foreign bodies? Perhaps there is no one evil now prevalent in this country, not even the intemperate use of alcoholic drinks, which has more vital importance to the health of the people than the adulteration of our foods.

In the short time allowed to this paper I cannot enter into an elaborate discussion of the nature and extent of food adulteration, but must confine myself closely to the question under discussion, the influence of this adulteration on the public health.

Not long ago I stated, before the Senate Committee investigating the adulteration of foods, that all adulterations of human food might be comprised in three classes. The first I described as adulteration with bodies which are innocuous or harmless; the second, the addition of positively injurious bodies; and the third as the abstraction of some valuable constituent from the food, and either leaving the food without this constituent altogether, or replacing it by one less valuable.

A distinguished gentleman, who followed me on the witness stand, took exception to the classification I had made, saying that in his opinion there was no kind of adulteration which was not injurious to health and that therefore the first class mentioned by me was just as objectionable as the other two. During the last few months I have thought a great deal on this point and have almost come to the conclusion that my friend was right in his view. I will illustrate the classification, however, by pointing out a few well-known adulterations of each of the three classes I have just mentioned.

It is well-known that flour made from wheat has been largely adulterated in this country by the addition of purely starchy matter derived from Indian corn. Now I cannot regard starch as injurious to health, and hence the addition of a starchy body to the flour of wheat is in this sense not an injury. Physiological chemists, however, have discovered that there is a certain balance in the foods of man which should not be disturbed. In other words, there is a definite relation between the quantities of protein, fat and carbohydrate matters, which, when sustained, renders this mixed food most nutritious, and therefore most economical. Bread made from wheat flour,

especially if it be made as nearly as possible from the whole grain, is recognized by physicians and physiologists as being practically a complete human food, with a certain definite ratio existing between the protein matter which it contains and the fats and carbohydrates. It is evident at once that the addition of other starchy matter will disturb this ratio and thus render the food less economical, by increasing enormously one of its constituents without changing the quantities of the others. For the ordinary healthy stomach such a change in the food would be of no consequence whatever, but we can readily imagine cases where, with the disturbed digestion and imperfect secretion of the enzymes which produce fermentations characteristic of the digestive process, the increase in the amount of starch would produce a positive injury. We know that starch is digested first in the mouth by the action of enzymes of a diastatic nature, secreted by the salivary glands. The slight alkalinity of the digestive fluid favors the action of the salivary enzymes. When the food reaches the stomach, in natural digestion, it becomes acid under the action of the hydrochloric acid secreted by the glands of the stomach. The enzymes of the peptic ferments are also secreted in large quantities and act rapidly upon the protein matter of the food, converting it into peptone. This action is favored by a slight acidity. It is evident, therefore, if the digestion of the starch does not proceed under the most favorable conditions in the stomach, any excess of starchy food may interfere seriously with proteolysis. In other words, the amylolytic ferments and the proteolytic ferments do not reach their maximum activity in the same environment. The mixing of Indian corn starch, therefore, with wheat flour, while it is an adulteration of the first class, being the addition of a harmless or innocuous substance, may in the cases mentioned above, become a positive injury to health.

Another illustration which may be cited is in the case of the glucose of commerce. Now, the glucose of commerce is a mixture of dextrose and dextrine with a small quantity of maltose, produced by the artificial hydrolysis of the starch under the influence of an acid. It is well-known that the starch in foods must undergo a similar hydrolysis, under the action of the diastatic ferments, of the digestive organisms, before it can be assimilated and act as a nutrient for the body. From this fact it might be inferred that a partial previous digestion of the starch, by an artificial hydrolysis, such as is referred to above, might be of advantage. This, however, cannot be seriously admitted. It is a well established principle in physiology that the disuse of organs tends to produce atrophy and eventually functional paralysis. Hence, if the starchy foods are replaced by artificially digested starch, the organs which produce the diastatic ferments to hydrolyze the starch, are deprived of a part of their functions and

must suffer from disuse. It is evident, therefore, from this point of view, that the use of predigested starch is to a certain extent prejudicial to the health of the digestive organs. Where the digestive ferments are deranged and the digestion of starch rendered difficult, the addition of predigested foods may be useful, but these should not be substituted for the natural foods, except on the recommendation of a competent physician. Again, there may be objections to the use of glucose from another point of view. This substance is, as is well-known, largely used as an adulterant for honey and jelly. Honey owes its value to the peculiar flavor which it possesses, due to the aromatic substances derived from the flowers and possibly to traces of formic acid, obtained from the digestive organs of the bee. In other words, honey is not prized simply because it is a carbohydrate, but because of its flavor. Whenever, therefore, glucose is added to honey, by the substitution of it for the aromatic substances, above mentioned, the peculiar flavor is destroyed and the honey is to that extent less desirable. So here is another instance in which the introduction of a perfectly harmless substance in food may render it positively injurious.

I will not multiply illustrations of this kind, but in general it may be predicted of all such adulterations, with harmless or innocuous substances, that they may be comprised within my first class.

When we come to the second class of adulterations there is less ground for dispute. Here I think no physician will fail to condemn the use of bodies in foods which are positively injurious. The excuse usually urged for the use of these bodies is that they are in such minute quantities that they cannot possibly be injurious. This I readily grant is valid for healthy stomachs, of individuals who are in the prime of life and who are in the full possession of all their powers; but it can hardly be general in its application.

Adulterants of this class are best illustrated in the use of preservatives. For economical reasons foods are not always consumed on the spot where they are produced nor at the time of their production. Many foods are of a perishable nature and if not consumed at the time of their maturity are lost. To render these foods servicable through the entire year, and in localities widely separted from the place of their origin, some method of conservation must be employed.

There are two methods of food preservation which are perfectly natural and permissible. One consists in the complete desiccation of the food so as to prevent the fermentation which produces decay. The second method is to subject the food to a pasteurizing or sterilizing temperature for a time sufficiently long to destroy the germs of fermentation. The foods thus pasteurized or sterilized are prevented from coming into contact with the air, and thus by excluding the fer-

mentative germs they can be preserved indefinitely. Both of these processes are to a certain extent troublesome and expensive and hence dealers in foods have sought to accomplish the same result by a shorter and easier course, namely, the employment of certain chemicals which have the property of retarding, paralyzing or destroying the activity of the fermentative germs. All food preservatives act essentially in the same way.

It is well-known that there are a great many substances which possess neither taste nor odor and which have this retarding action upon the fermentative germs. The addition of these bodies to foods secures their preservation and at the same time does not impair their flavor. Among the preservatives which have been commonly employed in this way may be mentioned sodium sulfite, boracic acid, borax, potassium nitrate, sodium chlorid, sodium silico-flourid, potassium flourid, sulfurous acid, formaldehyde, salicylic acid, benzoic acid. abrastol and saccharin. A glance at these substances will show that they are of two general kinds, those of an inorganic nature which are mentioned first, beginning with sodium sulfite and those of an organic nature, beginning with formaldehyde. I have omitted all preservatives which on account of odor or taste could not be conveniently used in the preservation of human foods.

It will be noticed that some of the bodies in the first class are of a condimentary nature and therefore cannot be rigidly considered as food preservatives. We must not exclude from foods the condiments with which we are familiar. They are necessary and desirable, although being of themselves of little food value, and hence the use of any one of the bodies mentioned above, in a condimentary sense, cannot be considered reprehensible. Of the bodies mentioned above, those which are most commonly used as condiments are common salt and potassium nitrate, the latter, however, to a very limited extent.

In the second class the only one which is used in the condimentary sense is saccharin and that only as a rule in the case of persons suffering from diabetes, where the use of a carbohydrate in the food is deemed inadvisable, and where the patient craves a sweet taste in his food. In the case of this condiment I cannot speak favorably since under any circumstances I consider its use highly injudicious and injurious.

In general it may be said that all decay of foods is due to germ action. I can easily remember the time when it was supposed that the decay of organic matter was due to oxidation by the air, but since the time of Pasteur this idea is no longer entertained. The sole function of the addition of preservatives, therefore, is to paralyze or suspend the germ action and thus preserve the foods from decay. On the other hand, we should not forget that the process of digestion is

essentially a fermentation from beginning to end. The splitting up of the organic food elements into simpler forms, which can be assimilated and utilized in the system, is due solely to the action of ferments, belonging to the general class of enzymes.

The decay of foods is due to fermentative action, caused by organisms, capable of reproducing their kind, and to the enzymes which are secreted by the living organ. The process of digestion in the alimentary canal is due almost solely to the latter cause, the action of the germs capable of self reproduction being extremely limited, and even doubtful. It may be stated, however, that any substance which has the property of suspending or retarding the action of germs capable of reproduction has a similar action upon the enzymic ferments. Therefore it follows that when these substances, which are added to preserve foods, reach the alimentary canal their paralyzing action will continue during the process of digestion. Hence this broad principle should be enunciated, as being definitely established, that all substances which are capable of preserving foods have also the property, to a certain extent, of retarding the processes of digestion.

The question therefore arises should the use of preservatives in foods be absolutely prohibited. I for one do not believe in prohibition of any kind. To my mind every human being should be left absolutely free to choose for himself what he should eat and what he should drink. If, therefore, my neighbor is fond of food preservatives, I, for one, have no desire to prohibit his indulgence therein. My duty and it seems to me, and that of every other teacher of hygiene, is to protect the innocent party who has no desire to eat adulterated foods. So far as I am concerned, therefore, and so far as the public health is concerned, it would be sufficient to permit the use of the least harmful preservatives, on the condition that the kind and amount of the preservative employed be marked in plain letters on every package containing it. When it comes to positively injurious preservatives, however, which even in minute quantities are injurious to health, then I too almost become a prohibitionist and would favor the restriction by national or state laws of the use of such substances in human foods.

It is claimed, for instance, by many competent hygienists and physiologists that a moderate use of borax or boracic acid in butter is of a condimentary as well as of a preservative nature and does not in any way tend to interfere with the process of digestion. Claims made in this manner are worthy of consideration. It seems to me, therefore, that it is eminently proper that this body of physicians assembled in the interests of the public health, should petition the Congress of the United States to enact one of the many pure food measures which have been brought to its attention, into a national statute, and provide at the same time for the appointment of a commission composed

of physicians, physiologists and chemists, to study the nature of all proposed food preservatives and to determine which, if any, should be permissible in human foods.

There is one other form of food adulteration to which the attention of this body should be called and that is the artificial coloring of foods. Artificial colors are now used to a large extent in human foods, chiefly in butter and oleomargarine, canned meats and preserved vegetables. Butter and oleomargarine were formerly colored yellow with turmeric. The introduction of the coal tar dyes provided a cheaper coloring matter and one of the azo-dyes, tropæolin, which gives a bright yellow color and at a smaller expense has almost entirely replaced the vegetable coloring matter first mentioned. As a result of this use, turmeric has practically disappeared from the dairy and the synthetic yellow has taken its place. I would regard the use of coal tar compounds as practically in the same category with the organic preservatives above mentioned. While I would not go so far as to prohibit the use of coloring matters in dairy products, I am sorry to say that their use is carried to such an extent as to excite apprehension. In many of our first-class hotels and restaurants the butter is colored a deep saffron tint, totally unlike the delicate light yellow tint which the best natural dairy butter possesses. To my mind the dairyman would do far better to regulate the food of his cows so that his butter would not require artificial coloring matter. In summer this can be easily accomplished by paying careful attention to the grazing of the animals, and in winter can be secured by feeding them root crops, especially beets and carrots in sufficient proportions to give the proper color to the cream and at the same time to increase the flow of milk and preserve the health of the animals. In so far as oleomargarine is concerned, it appears to be entitled to no color at all, but if color is desired it must be secured by some of the methods mentioned.

For the coloring of sausages and preserved meats the coal tar products are chiefly employed. The following is a list of some of the colors which have been used: Bismarck brown, buffalo brown, double scarlet, rouge I, and a red coloring mixture composed of common salt, sodium nitrate, borax and carmin.

The addition of nitrate of soda and nitrate of potash to sausages and meats tends to preserve and at the same time to intensify the red color of the meat. I believe that potassium nitrate is uniformly employed by all packers of corned beef so that it may be considered as a normal constituent thereof.

The green color of peas and beans and other green vegetables, which are preserved by sterilization, is fixed by the use of zinc and copper salts. These bodies act as a mordant, entering the tissues of

the green plants and fixing the chlorophyll, by preventing its transformation into xanthophyll, which would otherwise occur on long keeping. Green peas which are pasteurized without the addition of zinc or copper become yellow by the production of xanthophyll, while if zinc or copper salts be employed the green color is preserved indefinitely. It is well-known that zinc and copper salts are not particularly wholesome, hence their use in preserved vegetables is to that extent reprehensible. How far we should sacrifice our esthetic ideas, as to what food should look like, to purity must be determined by each one for himself. It appears to me that it would be a sufficient protection to the public to require that every package of preserved vegetables, containing copper and zinc salts, should have that fact plainly marked upon the label.

Examples of food adulteration which arise from the extraction of some valuable ingredient from the food and the substitution of a less valuable ingredient are also very numerous. The removal of cream from milk, before it is sold, is a very good illustration of this kind of adulteration. Happily, in most of our large cities at the present day, the milk inspection is so rigid as to practically prevent such adulteration. The laws of most of our large cities require that the milk offered for sale shall contain not less than a certain quantity of fat. The minimum limit is usually three or three and one-half per cent. The content of fat in the milk from a Jersey herd of cows often reaches five per cent. It is thus seen that the thrifty dealer can remove two-fifths of what the natural milk contains and yet sell his article in conformity with the statute. Nevertheless, the removal of this amount of fat is in every sense of the word an adulteration and should receive the same punishment as if it were extended until the limit fixed for the fat had been transgressed.

The use of skimmed milk in cheese making with the addition of lard and cotton seed oil is another illustration. Such a product is known in the trade as "filled cheese." Another common substitution is that of cotton seed oil for olive oil which has been practiced to an enormous extent in this country. This to my mind is a clear case of an adulteration which is not injurious to health. I consider cotton seed oil perfectly wholesome, as much so as olive oil. The fraud in this instance is purely a monetary one, but the offense is just as great and the punishment should be as severe.

From this brief summary of some of the methods of food adulterations it is clearly seen that the practice of frauds of this kind is usually more to be regarded from a monetary point of view than as prejudicial to the public health. Traffic in adulterated foods between the states and territories should be regulated by an act of Congress, while the

legal regulations for the commerce in and sale of these foods should be left to the boards of health of the various states. If national legislation could be brought to act in harmony with state legislation, on this subject, a complete control of traffic in these foods could be instituted, which would be an ample protection of the public, both as far as its pocketbooks and health are concerned.

I will close with one word of warning. When a public audience hears a discussion on the subject of food adulteration it is likely to form wrong notions in regard to the extent of this evil. Exaggerated impressions are formed and expression is often given to them. One would think from some of the articles which have appeared in the newspapers that it would be quite impossible to secure a pure food in any of the markets of the United States. Nothing could be more erroneous than this idea. Most of the foods which are offered on our markets are perfectly pure and wholesome. If one should go into one of our great cities to-day and purchase one hundred articles of food at random perhaps less than five per cent. of them would be found to be adulterated; but because the percentage of food adulteration is small there is no reason to minimize its evils.

The sole objects of food adulteration are to sell an inferior article at the price of a superior one and to preserve a good article, so that it can be sold after preservation at the same price or at a higher price than it would bring in its natural fresh state, and to secure this object reprehensible methods are employed.

I would not say or do anything that would make the price of the food higher for the working man or the poorer classes of this country. I am a thorough believer in the production of oleomargarine and the sale of it as such to those who desire to pay a less price than pure butter commands, and in like manner anyone who prefers glucose to honey, simply because it is cheaper, should be allowed to gratify his taste. My plea is that foods should be sold everywhere for what they are, while the greatest liberty is granted in their manufacture and preservation compatible with the public health. Only where actual injury is done should prohibition be practiced, but up to this point a plain marking of the food containing preservatives or adulterants of any kind, under the proper operation of the state and national laws, would be entirely effective.